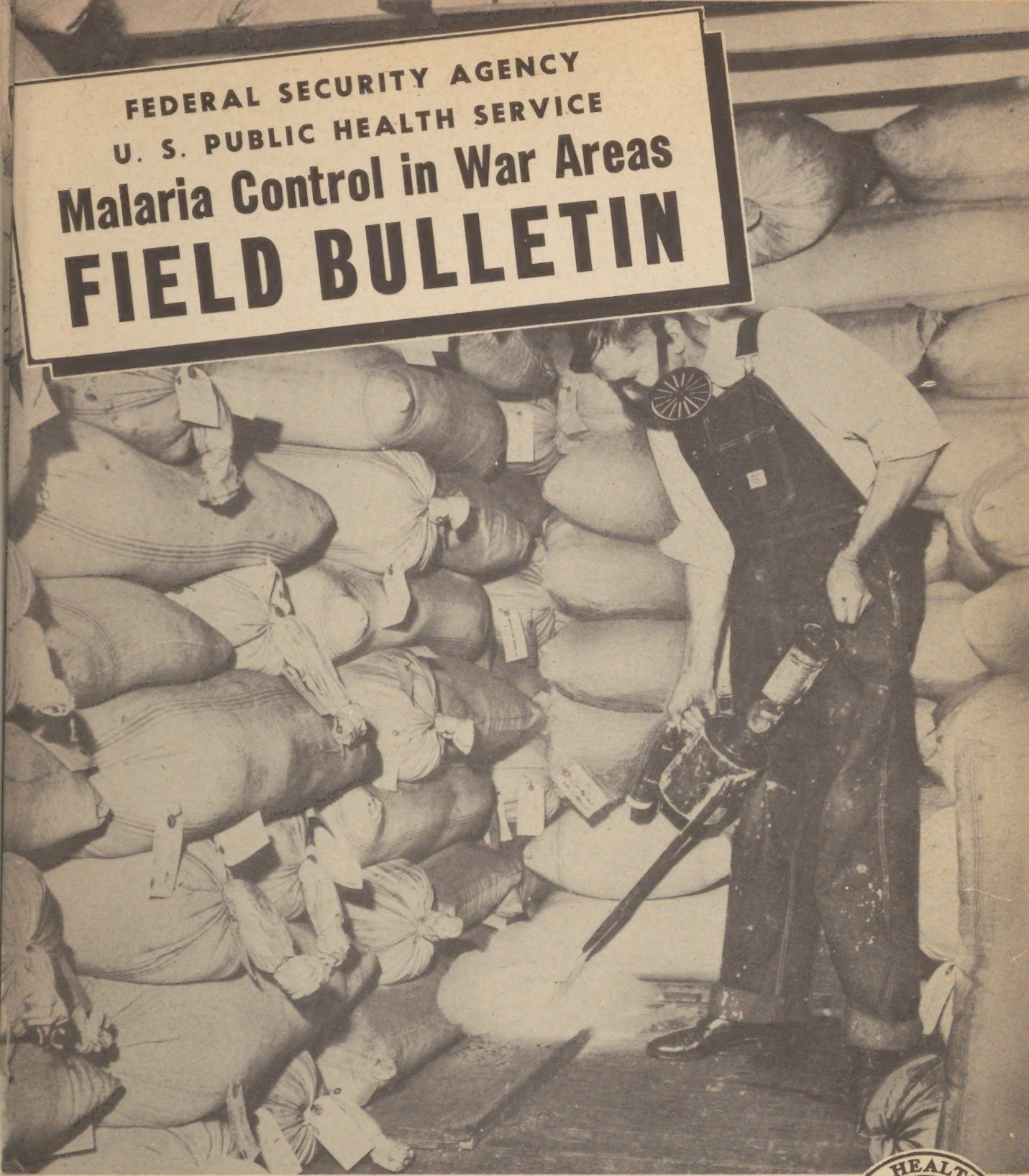
FEDERAL SECURITY AGENCY

U. S. PUBLIC HEALTH SERVICE

Malaria Control in War Areas

FIELD BULLETIN



TYPHUS CONTROL PROGRAM OF THE
U. S. PUBLIC HEALTH SERVICE

ATLANTA, GEORGIA

JULY, 1945

Table I

MCWA Larvicide, Minor And Major Drainage Work

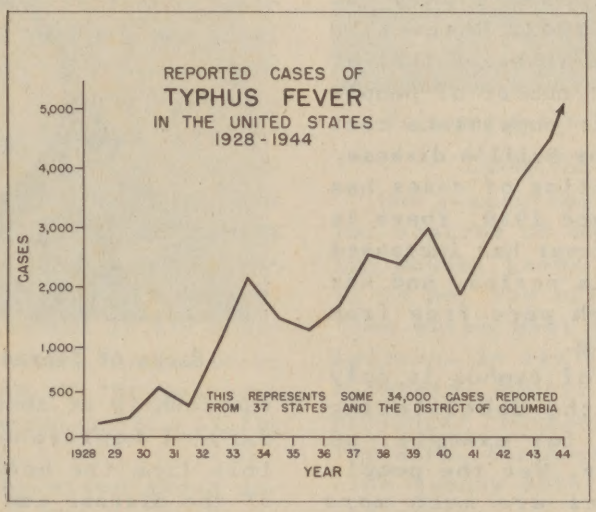
June 1 - 30, 1945

STATE	Areas in Operation	Residual Number Houses Sprayed	Spraying Pounds DDT Used	LARVICIDAL WORK				DRAINAGE OPERATIONS										Total Man Hours
				Larvicide Used		Surfaces Treated Acres		Clearing		Cleaning Hundred Sq. Ft.	New Ditching				Ditch Lining Lin.Ft.	Underground Drainage Lin.Ft.	Fill C.Y.	Water Surf. Eliminated Acres	
				Oil Gals.	Paris Green Lbs.	Oiled	Dusted	Removal Surf.Veg. Acres	Stumping Grubbing Acres		Hand	Lin.Ft. Mech.	Dynamite	Total Cu.Yds.					
Alabama	8	5,784	2,650	1,007	168	90	102	3	---	6,396	---	---	---	---	---	---	---	---	6,409
Arkansas	18	26,834	8,929	43,057	616	3,137	357	57	---	1,812	11,315	---	2,100	2,712	1,138	---	---	---	43,442
California	4	---	---	3,041	34	354	11	1	---	374	800	---	---	40	---	---	---	1	3,432
District I	2	---	---	719	290	55	54	20	---	20	505	---	---	26	---	---	---	---	5,086
Florida	15	4,108	3,048	698	729	61	648	23	1	14,336	22,649	---	1,374	3,623	840	450	6,125	4	24,370
Georgia	11	5,533	4,282	361	2,269	25	2,002	39	---	456	4,842	---	---	494	---	---	932	1	20,048
Illinois	2	---	---	391	4	13	1	30	---	68	1,030	---	---	429	---	---	---	16	4,451
Indiana	1	---	---	693	59	62	95	---	---	200	---	---	---	---	---	---	---	---	1,932
Kentucky	5	3,472	1,227	3,098	43	126	43	1	---	406	---	---	---	---	---	---	---	---	8,828
Louisiana	9	4,065	2,108	35,241	554	3,532	555	40	3	6,705	7,861	---	1,106	1,624	---	---	---	---	57,105
Maryland	1	---	---	---	---	---	---	29	---	---	---	---	---	---	---	---	---	---	7,283
Mississippi	20	16,107	6,989	16,543	800	696	540	106	2	3,209	144	---	---	125	---	---	26	---	21,913
Missouri	4	7,340	3,698	8,481	1,991	650	1,443	3	---	---	---	---	---	---	---	---	---	---	14,825
North Carolina	11	581	209	3,748	34	314	17	182	1	11,147	16,679	1,610	---	3,183	---	30	816	---	30,445
Oklahoma	9	1,752	551	6,073	135	344	84	48	5	3,045	10,165	---	---	862	---	---	27	1	17,470
Oregon	1	---	---	112	---	2	---	---	---	---	---	---	---	---	---	---	---	---	104
Puerto Rico	7	---	---	2,267	3,690	200	3,135	21	---	6,755	15,080	---	---	2,675	20	---	---	7	52,709
South Carolina	20	11,118	5,307	9,377	242	572	228	306	2	29,858	9,139	---	---	868	---	150	167	10	66,067
Tennessee	3	3,246	1,409	10,815	128	517	73	3	2	24	810	---	---	44	65	---	6	---	16,313
Texas	14	10,030	4,138	14,369	222	642	213	164	1	5,271	16,111	---	---	707	---	---	5	8	48,929
Virginia	4	---	---	5,997	542	172	269	82	1	2,410	49,750	---	---	3,717	---	---	124	---	25,038
Mobile Units	--	---	---	520	103	48	136	3	---	---	---	---	---	---	---	---	---	---	3,032
Total	169	99,970	44,545	216,608	12,653	11,612	10,006	1,161	18	92,492	166,880	1,610	4,580	21,129	2,063	630	8,228	48	479,231
May Total	170	99,546	38,393	198,247	17,775	7,087	8,448	2,282	32	110,921	178,652	3,605	4,259	23,710	4,697	1,238	10,238	147	475,775

TYPHUS CONTROL PROGRAM OF THE U. S. PUBLIC HEALTH SERVICE

By S. A. San. Eng. John S. Wiley

Murine or endemic typhus fever is a disease existing in nearly every part of the world. Rats are the natural reservoirs of infection, fleas the probable vectors transmitting the disease from rat to rat, and from rat to man. Other closely related diseases of the typhus group of fevers include the louseborne or epidemic type, sometimes called Old World typhus and scrub or miteborne typhus.



Louse-borne typhus readily reaches epidemic proportions in places where louse-infested people are crowded together in filth and squalor. It is ancient in origin, wide spread in distribution and closely associated with crowded conditions existing during times of war and famine. These conditions are favorable for the louse vector which spreads the disease from person to person very rapidly.

Murine typhus seldom assumes the epidemic status of the louse-borne type. The virus is somewhat less virulent, and normally the fleas which live on rats are not in as close contact with man as human-inhabiting lice.

Scrub or mite-borne typhus is sometimes called field typhus. Larval forms of the genus *Trombicula* (red bugs) are frequently the vectors for this type. A small ulcer usually forms at the site of the infective bite.

The terms "New World" for murine typhus and "Old World" for louse-borne typhus are not universally applicable, because the louse-borne typhus occurs in the western as well as in the eastern hemisphere, and murine typhus is found in both the Old and the New Worlds.

According to Public Health Reports, some 63,000 cases of typhus fever were reported to have occurred in foreign countries during the first ten months of 1944. The account states, "Reports from some of the 63 areas are probably murine typhus, while others may include both murine and louse-borne typhus." It seems likely that a number of these cases may be mite-borne typhus, because this disease is a problem in Asia, Australia, and the South Pacific.

More than 5,300 cases of the murine type of typhus fever were reported to public health departments in this country during 1944. This was the greatest number recorded in the United States for one year. It is an increase of 800 cases over the previous year. The 1944 figure exceeds the total number of cases for the five-year period, 1930-34.

Since 1940 the increase in numbers of cases reported has been so rapid that typhus fever is recognized as a major health problem in Southern and Southeastern United States. However, the reporting of actual cases has been far from complete. It is believed that the 5,300 figure really represents approximately 1/3 to 1/5 the total number of cases which occurred during 1944. It is very probable that the number of cases occurring for the other years greatly exceeds the figures reported for them.

To illustrate the incompleteness of reporting, in one state, no cases were

reported from a certain county during 1941 and 1942, and only one for 1943, yet it is known that ten cases were hospitalized during September of the latter year. Following the publicity given by a typhus control program instigated in the largest city of this county, 69 cases were reported for 1944.

A southeastern Alabama county reported 68 cases for 1943. However, a house to house checkup revealed that at least three times that number of people had been told by their physicians that they had typhus fever or Brill's disease.

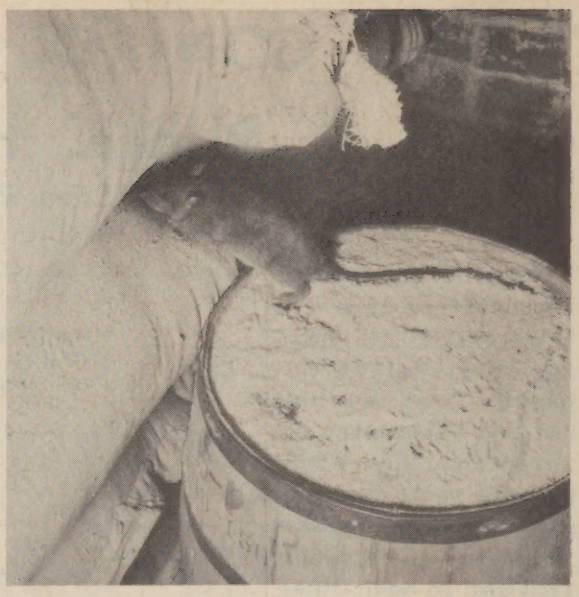
Although the reporting of cases has probably improved since 1939, there is evidence that typhus fever has increased materially during this period, and has spread to areas which were free from the disease previously.

The fatality rate of typhus is only about 2 to 5%, but the debilitating effect is as great, for example, as that of typhoid fever. Yet the people of the United States are much more keenly aware of typhoid fever than they are of typhus.

SPECIAL AREAS FAVORING TYPHUS FEVER

According to Dr. C. R. Eskey, climatic conditions most favorable for the widespread occurrence of murine typhus fever in the United States lie south of 33° north latitude. This line crosses

Rats Enter Buildings through Openings Around Pipes



Sacks of Stored Feed Attract Rats

the country at about the northern boundary of Louisiana. In areas north of this line the occasional transmission of the disease can be traced almost invariably to foci that are business establishments. This is especially true of buildings in which food is handled, as distinguished from residential and rural areas. As an example, all of South Carolina with the exception of the southern tip, lies north of 33° north latitude, and, according to Dr. G. E. McDaniel, Director, Division of Preventable Diseases, State Health Department, out of a total of 171 cases of typhus fever reported in South Carolina during 1944, not more than one or two known cases were contracted in rural areas.

The rise in the number of reported cases is coincidental with the increase in crop storage and the development of peanut culture in the South, and is confined to areas in which leguminous crops are stored. During 1944 there were 116 rural cases of murine typhus in Houston County, Alabama, but only 38 in the city of Dothan. Based on the 1940 census, the incidence in the rural area of the county was nearly twice that of Dothan. Lavaca County, Texas, which is 75% rural, reported the highest incidence in the country, 438 cases per 100,000 population.

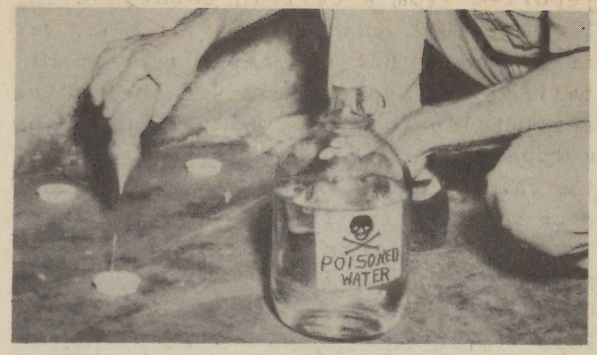
In contrast to this, south of the 33° north latitude line typhus fever appears to be contracted about as extensively in residential and rural sections as it is in the business areas of cities and towns.

In highly endemic areas of the South, the majority of the rats collected, both in the urban and rural sections are found to be typhus-infected. In the northern part of the country, typhus fever is usually restricted to limited areas of the business sections of cities. Since a great many more persons come into close proximity to infected rats in business establishments where rats are more plentiful than at home, it appears logical to start control procedures in the business sections of the towns. This is practical for any section of the country, and has been the general policy of the Typhus Control Unit.

The following tabulation shows incidence according to the latitude in seaports for the 4 years 1938-1941.

CITY	LATITUDE	AVERAGE PER 100,000
Philadelphia, Penn.	40°	.04
Baltimore, Md.	39°30'	.32
Norfolk, Va.	36°50'	2.92
Charleston, S.C.	32°40'	36.33
Savannah, Ga.	32°	74.17

Rat Runs along Tiers of Stored Sugar



Poisoned Water for Control of Rats

CHARACTER OF OUTBREAKS

One reason for an increasing demand for control of murine typhus fever in the South, grows out of the fact that it is not the mild, occasional infection which most textbooks lead us to believe. In reality, it is frequently a severe, acute, disease, followed by prolonged convalescence and disability for work. Furthermore, some of the murine typhus outbreaks are epidemic in character.

As an example of this, 38 cases of the disease and 2 deaths occurred at Wilson, North Carolina during July and August. In Laredo, Texas more than 90 cases were reported for the same months. Following these outbreaks which reached epidemic proportions, typhus control programs were instituted.

If an establishment becomes infected, every individual employed as well as some of the patrons may become infected with typhus fever within a very short time. Such an outbreak occurred at Austin, Texas during June and July of 1943. This outbreak involved 15 employees and 3 customers. Outbreaks of epidemic proportions can usually be tracto definite foci.

EFFECTS OF AGE AND SEX

Cases of typhus fever contracted during childhood are usually mild infections. There have even been cases reported among babies. The majority of cases, however, are among workers, or persons more than 18 years of age. The number of reported cases of males usually exceeds that of females by a retio of at least two to one.

Traps are Set in Places Showing Evidence of Rats

TYPHUS FEVER AND SOCIAL STATUS

Typhus fever is no respector of persons or positions. The owners and managers of infected establishments are just as likely to get the disease as are the employees. Any number of prominent civic leaders have had it. Cases have been reported among persons patronizing typhus-infected stock food stores. Sources of infection for two typhus outbreaks, one of 6 cases and the other of 7, were traced to eating places. The relatively high incidence among housewives may indicate that grocery stores are sources of infection.

RESERVOIRS OF INFECTION

Practically all wild rodents and many other animals have been found susceptible to infection with the rickettisiae of typhus, *Rickettsia prowazeki mooseri*, but the domestic rat is the chief reservoir and source of infection so far as man is concerned. Rickettsiae have been found in the urine of rats. This may be a possible source of infection, the disease being acquired by contamination of food or eating utensils.

It is possible that mice are responsible for many human cases of the disease, but mouse infection is likely to occur only during rat epizootics. The infection has been found to persist in the brain of the white mouse for 5 months.

In a number of instances human infection has been attributed to contact with cats.

The cotton rat has been found naturally infected, but whether or not the disease is being disseminated through wild rodents is unknown.

OTHER SOURCES OF INFECTION

The rickettsiae of typhus fever seem to be transmitted from rat to rat by rat fleas. Humans contact the disease from rats or from fleas, but the exact mechanism of the transmission is not entirely clear.

It is possible that humans are infected with typhus rickettsiae through infected feces or rodent ectoparasites. Experiments show that rickettsiae are excreted in feces of lice and fleas. Dyer and others have found that guinea pigs can be infected by rubbing a very small amount of feces from the Oriental rat flea, *Xenopsylla cheopis*, into the scarified skin.

Rickettsiae in flea feces may retain their virulence for periods of a month or more. Floors, shelves, and exterior surfaces of buildings which harbor typhus-infected rats and their parasites may be contaminated by infectious ectoparasite feces dislodged from fur of rats, or deposited by fleas which have become separated from their hosts.

The possibility that persons may become infected through infectious feces, without being bitten by the parasites is very strong. The victim might inhale dust containing small particles of infectious feces. Or he may ingest contaminated food or transfer infectious feces adhering to the fingers to

Garbage and Dump Area Before Ratproofing

his mouth. He could rub the organisms into open wounds when handling contaminated objects such as sacks and boxes. Crushing infected parasites on the skin is a possible but not a very probable means of infection.

SEASONAL INCIDENCE

Cases of typhus fever are reported from various regions throughout the entire year, but the incidence is very small from January to May. The peak in seasonal incidence varies in different localities. In many regions it is reached during November or December, but in most places the greatest number of cases are reported during July and August.

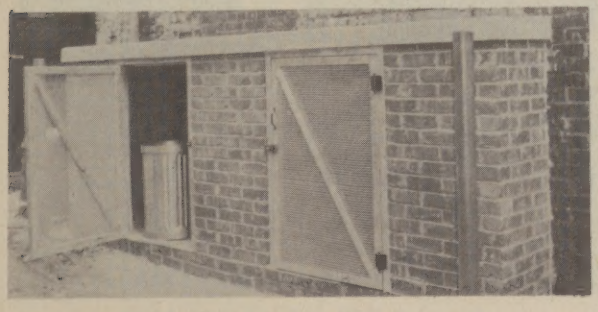
EARLY TYPHUS ACTIVITIES

In July 1942, the Typhus Control Unit was formed. This was an outgrowth of limited typhus control activities started earlier, and was used primarily as a field unit for demonstrating ratproofing. Medical Director C. R. Eskey, who has had wide experience in both plague and rat control at the U. S. Public Health Service Plague Laboratory in South America, and in Hawaii, was appointed Medical Officer in Charge.

TYPHUS CONTROL UNIT MEASURES

In cooperation with the various municipalities, the Typhus Control Unit participated in and is continuing to carry on a number of activities for controlling rats.

Ratproofing of establishments is one method used extensively. This consists of closing all the openings through which rats may enter buildings. Screens are



Same Area After Ratproofing

Mobile Typhus Control Unit at Work

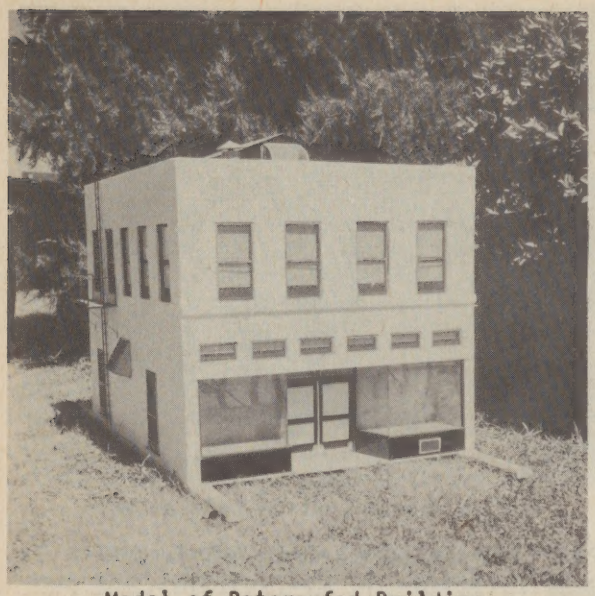
provided for doors, windows, vents or other openings to the outside, and tunnels are closed around pipes which lead into establishments.

Inspection of buildings to determine the degree of rat infestation already present and the extent of exterior ratproofing needed, proceeds on a block to block basis. The cost of necessary labor and materials is estimated. Owners of establishments are contacted, and agreements signed by them to pay necessary costs of the work.

It is sometimes necessary to construct curtain walls or cement ground floors to ratproof a building. Curtain walls are built vertically 18 in. below the surface of the ground, and 12 in. horizontally from the lower part of the curtain. This prevents rats from digging under the building and coming up through the floor.

Three to seven days before a building is to be ratproofed, a program of rat eradication begins. Poison bait is distributed both inside and outside the establishment. A number of different kinds of bait are used because rats aren't all attracted to the same kind. Poisons most commonly used in preparing poison bait are red squill powder and extract 1-10, arsenic 5% and barium carbonate 1-5.

Poison water is used very profitably in conjunction with poison bait. Three ounces of arsenious acid dissolved in one gallon of boiling water is



Model of Ratproofed Building

excellent. However, all other sources of water should be eliminated. The poisoned water should be placed in regions which are not accessible to other animals such as pets and chickens.

Preliminary trapping of rats is started before ratproofing is completed. Traps are placed in areas showing definite signs of the presence of rats. Steel traps should be well fastened so the rats won't carry the traps away.

In large grain warehouses and other large buildings which are rat infested, fumigation with hydrocyanic acid gas is used whenever practicable.

The success of the program depends largely upon the completion of all organizational phases, and the manner in which operations proceed in the first few blocks.

SUMMARY OF THREE YEAR PERIOD

During the three year period of its existence, representatives of the Typhus Control Unit have participated in 61 ratproofing programs in 14 states and Puerto Rico. They have cooperated with state and local health departments to reduce the spread of murine typhus fever in the southern states. Assistance offered by the Typhus Control Unit has been limited to the assignment of trained personnel to local health departments for the purpose of organizing the projects and assisting in their operations long enough to train local inspectors in all aspects of the work. As all the labor except supervisors and all the equipment with the exception of a few minor items have been furnished locally and paid for by the beneficiaries of the work, the owners and occupants, the cost of work done greatly exceeded the small budget of the Typhus Control Program.

Each program has been designed as a permanent part of the local health program and requires continuous inspection with the necessary corrections if it is to be a success in controlling rats and typhus fever. Without maintenance, leaks due to accidents, carelessness or rat gnawing will develop in the exterior of many buildings. Rats may become reestablished as a result of such leaks in ratproofing or they may gain entrance through open doors. To cope with these conditions, all the treated buildings should be inspected for leaks and reinfestation every four to six weeks.

SEARCH FOR NEW METHODS

Although ratproofing and rat eradication projects are the best known methods for permanent control, they are slow and have not proved to be the sole answer for the control of typhus in

Foot Pump for DDT Dusting

areas where the disease is most prevalent and widespread.

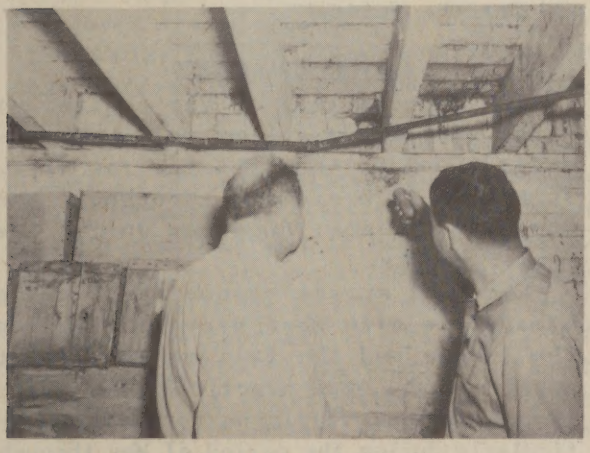
In areas of highest endemicity a large number of the cases occur in rural and residential sections. It is also in these areas that most of the homes, the farms, and other buildings are not amenable to ratproofing.

If regularly repeated poisoning programs are carried out at three-month intervals, it is possible that the rat infestation may be kept sufficiently light to control typhus. This type of program, however, is quite expensive, so a search was made for a speedy, effective, and relatively inexpensive type of typhus control.

TEXAS PRESENTS NEW METHODS

Experiments by representatives of the Typhus Control Unit in San Antonio, indicated that DDT might prove an effective control agent and produce desired results by fighting the rat fleas which transmit typhus, rather than by destroying the rats which harbor the vectors. Experiments showed that dusting a 10% DDT powder in rat runs, harborages, burrows, possible nesting places, and other points where rats travel, proved effective in reducing the degree of infestation of rat fleas.

Experiments were also carried on in other areas, and similar results were obtained.



Hand Shaker for DDT Dusting

Inspecting Basement for Rat Evidence

CONSOLIDATION OF PROGRAM WITH MCWA

On July 1, 1945, typhus control activities of the Public Health Service were transferred to the Office of Malaria Control in War Areas.

In integrating typhus control into the MCWA program, personnel and equipment are to be used interchangably in typhus, malaria, and *Aedes aegypti* control operations insofar as practicable.

ORGANIZATION PLANS

The first step in organizing the new program was to locate specific areas in which typhus control work was most needed. After the Medical Division of MCWA considered epidemiological evidence, it pre-approved dusting operations in 140 counties of the nine states showing greatest prevalence of the disease. The nine states are: Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Texas.

Programs in the various states were organized under the state health departments along the general lines of the MCWA program. In most cases the state MCWA administrative office assumed administration of the state typhus control unit. In many instances, at the request of the State Health Officer, personnel of the Typhus Control Unit were assigned to the state office.

To eliminate duplication of reporting, and to provide close integration with other MCWA activities, consolidated project proposal and progress report forms were set up.

Dusting Rat Runs with Hand Pump

The existing manual of operations is being rewritten to include typhus and *aegypti* control as well as malaria control.

A number of technical memoranda have been prepared and transmitted to the district and state offices to familiarize all concerned with the latest typhus control information.

TRAINING AND EDUCATION

July 24-25 of this year, a school was conducted at Savannah to demonstrate to state personnel the DDT dusting equipment and methods which had been developed at Carter Memorial Laboratory. Two film strips on DDT dusting and evaluation are being prepared for distribution to the states.

In order to inaugurate residual dusting projects as rapidly as possible, state representatives were urged to train other personnel at specified programs within the state. A six weeks program is being planned for Atlanta. This is designed to train MCWA personnel who have been engaged in other than typhus control measures. Field training in ratproofing, rat eradication, DDT dusting, and general MCWA procedures will be included.

The shortage of trained personnel has been a limiting factor in initiating control programs, but the termination of the war should simplify the task of securing adequate supervisory personnel. The consolidation of the malaria, *Aedes aegypti* and typhus control activities in MCWA will permit the joint utilization of supervisory personnel, labor, equipment, and other facilities where more than one activity is in progress.

PRELIMINARY ARRANGEMENTS WITH LOCAL HEALTH DEPTS.

Prior to inauguration of activities the following items should be well established and thoroughly understood: publicity, records, methods of estimating and charging for the work, manner of notifying, billing and collecting, understandings relative to the duties and responsibilities of employees, policies relative to individuals desiring to perform the operations themselves, or the hiring of private contractors or pest control operators, and methods of enforcement of the ordinance. It is suggested that occupants be encouraged to continue existing contracts with private pest control operators for rat control, particularly for the permanent maintenance following the freeing of buildings of rats.

Training and education materials are being developed as rapidly as possible. These include a leaflet on DDT dusting which may be handed to occupants of premises in which control measures will be taken, and a pamphlet of residual dusting designed for the instruction of personnel. Additional film strips, and a movie on ratproofing and rat eradication are planned for the future.

DUSTING OPERATIONS

DDT dusting aims at the control of rodent ectoparasites, particularly *Xenopsylla cheopis*, the Oriental rat flea. This flea is prevalent throughout the south and is most numerous during the summer months.

Cases of murine typhus fever among humans are also more prevalent during the summer and the fall months. So it appears that, when practical, DDT dusting operations should be conducted particularly during the period of May through October. This is especially true in

Hand Dusting of Rat Harborage Areas

rural areas since it is at this time that barns, cribs, haymows, and other grain containers in which rats live or travel, are empty, or nearly so.

Rats living in warm buildings such as food establishments may have numerous ectoparasites the year around. Several wintertime outbreaks of typhus have been traced to such places, so the typhus problem under these circumstances may be considered a permanent, year around one.

Before dusting operations begin, buildings and premises should be thoroughly inspected to locate all signs of rats. These are usually found at food and water sources, resting places, and runways.

Ten per cent DDT dust should be placed in active rat runs, and in small patches around food, water, harboring places, entrances and in burrows where rats are traveling. As the rats move about in these areas, sufficient DDT adheres to their coats to be toxic to the fleas.

It is also important to dust such places as cat and dog houses and chicken coops, because rat fleas are often found on cats and dogs and in chicken houses. Little danger to the animals is experienced except in the case of small kittens.

Care must be taken in the use of DDT to prevent its being placed on open foods. Mixing color with it prevents confusion with foods and enables the evaluator or inspector to check the thoroughness of DDT dust application. In addition, it aids the occupants of the establishment in distinguishing this material from other substances.

TYPES OF DUSTERS

Several types of dusters are used for applying DDT dust. They include two kinds of hand shakers; a small one with a stick attached for dusting out-of-the-way runs and rafters, and a larger type for use in such places as exposed runs along walls. Another is the plunger pump; a hand variety dusts overhead lofts and places which are hard to reach, and the foot type is used in dusting burrows and enclosed harborages, and for broadcasting DDT dust in small areas. For broadcasting in larger areas, a rotary duster is used. This type, however, wastes a great deal of the dust.

EVALUATING PROCEDURES

Evaluating procedures for use on the DDT dusting program have been designed by Headquarters Entomology Division. Live rats are collected from dusted and undusted premises and the degree of infestation with fleas and other ectoparasites determined. Prevalence of typhus in rats is determined by a complement fixation test. This is done on a random sampling basis in each state. Blood is taken from the rats, centrifuged, and the serum sent to the laboratories and tested.

SPECIAL CONTROL COUNTIES

Headquarters Medical Division is establishing special observation projects in several counties. Comparative determination of rat population, the prevalence of typhus among rats and humans, and the degree of infestation of rats with fleas and other ectoparasites is to be made. One untreated county will be checked continuously while others will be checked before, during, and after the application of control measures. Evaluation of measures used against both rats and fleas will be used.

CARTER MEMORIAL LABORATORY EXPERIMENTS

Investigations are in progress at Carter Memorial Laboratory to further develop techniques and equipment for effective application of DDT dust. In addition, this station is conducting tests and experiments with rodenticides including 1080 and ANTU. The chemical known as ANTU may prove practical for killing rats. When used with flour in a 20% mixture and placed where rats travel, the rats which get it on their feet are usually, if not always killed. ANTU is very irritating and the rats try to get it off their feet by licking them, so ANTU acts as an internal poison. At present, it is available only for research purposes.

1080 EXPERIMENTAL PROJECTS

In each state, a number of projects are designated as "1080 Experimental projects. "In these areas, 1080 will be used exclusively. This poison is still in the experimental stage, so data will be checked carefully, and special reports prepared. As information on new techniques, equipment and materials becomes available, it will be passed on to the field workers through memoranda.

Removing Blood from Heart of Rat

Removing Ectoparasites from Rat

CONTROL IN NORTH AND SOUTH

Although control measures in the North are essentially the same as those employed in the South, they may be limited to small areas in cities which contain the foci of infection. These foci can be located by epidemiological investigation of cases, together with complement fixation tests for typhus on rat blood specimens. Experience indicates that the percentage of infected rats caught in any one place where humans have acquired murine typhus is generally 90% or higher. Control should be carried on in all sections where any infected rats are obtained, as it is always possible for such establishments to become foci for human infection.

TYPHUS PROGRAM WELL RECEIVED

The program which is in progress has been developed along sound technical lines. With the increase in use of DDT and the addition of newly developed poisons, greater progress in typhus control may be anticipated. The program is receiving support from health officials, city councilmen, businessmen, and the public in general. The new methods developed show promise as a practical method of controlling murine typhus in rural areas.

THE 140 COUNTIES FROM THE 9 STATES IN WHICH TYPHUS IS MOST PREVALENT

TEXAS

COUNTY	RANK
Bastrop	107
Bee	61
Bexer	12
Brown	108
Caldwell	104
Cameron	82
Comal	64
Dallas	30
De Witt	81
Erath	54
Fayette	28
Fisher	129
Galveston	78
Gonzales	36
Gray	122
Gundalupe	85
Harris	3
Henderson	87
Hidalgo	101
Houston	98
Howard	40
Jasper	48
Jefferson	23
Jim Wells	100
Jones	60
Lampases	99
Lavaca	2
Lee	102
Limestone	116
Live Oak	133
Lubbock	124
McLennan	41
Madison	68
Milam	77
Nueces	21
Orange	105
Runnels	55
San Patricio	63
Smith	138
Tarrant	22
Taylor	93
Travis	95
Victoria	96
Waller	26
Washington	80
Webb	18
Wharton	46
Wilbarger	140
Williamson	112
Wilson	88

FLORIDA

COUNTY	RANK
Dade	11
Duval	9
Escambia	31
Hillsborough	15
Marion	125
Nassau	114
Orange	86
Pinellas	73
Polk	127
Volusia	65
Walton	139

NORTH CAROLINA

COUNTY	RANK
Craven	35
Forsyth	120
Granville	121
Mecklenberg	113
New Hanover	69
Sampson	94
Wilson	91

SOUTH CAROLINA

COUNTY	RANK
Beaufort	134
Charleston	10
Marion	126
Orangeburg	75

LOUISIANA

PARISH	RANK
Acadia	111
Calcasieu	89
Orleans	8
St. Martin	118

MISSISSIPPI

COUNTY	RANK
Forrest	130
Hancock	131
Harrison	70
Hinds	106
Jones	132
Pike	137

ALABAMA

COUNTY	RANK
Barbour	57
Calhoun	103
Coffee	16
Covington	13
Crenshaw	79
Dale	20
Dallas	71
Escambia	109
Geneva	14
Hale	136
Henry	59
Houston	4
Jefferson	17
Mobile	5
Montgomery	58
Pike	25
Talladega	128

GEORGIA

COUNTY	RANK
Appling	24
Bibb	7
Brooks	84
Bullock	33
Burke	97
Calhoun	83
Chatham	1
Coffee	67
Colquitt	29
Crisp	44
Decatur	37
De Kalb	92
Dodge	27
Dooly	115
Dougherty	34
Early	42
Evans	135
Fulton	6
Glynn	43
Grady	39
Jenkins	76
Laurens	53
Mitchell	38
Peach	117
Pierce	74
Richmond	50
Schley	110
Screven	56
Seminole	51
Sumter	52
Tatnall	72
Telfair	45
Terrell	47
Thomas	49
Tift	32
Toombs	90
Ware	62
Wayne	119
Worth	66

TENNESSEE

COUNTY	RANK
Davidson	19
Knox	123

The nine states listed above reported more than 95% of all cases of typhus fever recorded in the United States during the past four years. Headquarters Medical Division has pre-approved DDT dusting in 140 counties of these states. The number beside each indicates the rank of that county according to prevalence of the disease.

Counties fringing the South Atlantic seaboard and Gulf coast show the heaviest typhus infection. The coastal strip varies in width from two to eight counties, and it is in this section that the disease is widespread in both rural and urban districts. Farther inland, severe localized foci exist, but these are confined mostly to local communities. A direct attack will be made on the insect vector by using DDT dust as a pulicide. Intensive dusting operations will treat runways, burrows, and similar places inside and outside establishments wherever rat infestation is in evidence in the selected areas. This phase of the work is designed to check the rising typhus incidence and curb its spread. Concurrently, ratproofing and rat eradication activities will continue.

AN EXPERIMENT IN FIELD TRAINING IN VIRGINIA

By Rowland E. Dorer, State MCWA Director

The need for training foremen and inspectors in the regular MCWA program has been recognized for some time. These men are in daily contact with the public, and are directly concerned with malaria control measures. It is essential, of course, that they known their particular part of the control job, but it is also important that they understand the fundamental facts behind the MCWA program so they can authoritatively answer questions which the public asks.

With this in mind, S.A. San. (R) Herbert Knutson assisted the staff in Virginia in organizing and conducting a field training course. Arrangements were made so that the course would interfere as little as possible with field operations. On June 24th it rained, which provided an opportunity to give the first field course to a group of 22 foremen, inspectors, and laborers. A screen was set up on a truck in a garage, and projectors were placed on an improvised table. The men sat on nail kegs and boxes.

Four sound films and one film strip were shown to the group. The films were "Anopheles Census," "Oil Larviciding," "Paris Green Larviciding," and "Winged Scourge." The film strip was "General Inspection and Control Activities at the Area Level." Discussion of the pictures was entirely informal, and questions were encouraged. The second class was attended by 7 office personnel at headquarters, and the third by 16 foremen, inspectors and laborers. Each session lasted about two hours. Education of those attending ranged from persons with grammar school education or less, to those with college degrees.

A set of 20 true and false questions was prepared. The questions covered the fundamental facts brought out in the pictures, and were designed to emphasize points on good control operation. They attempted to prepare the field man with the answers to questions asked most commonly by the public. Points missed by the various individuals were later cleared up by the area supervisors or general foremen. On the following page is the list of questions asked, and the results of the examinations.

These conclusions were reached following the field training course: (1) The course was needed, and was well received. (2) Material offered was good, and was understandable to the field men. (3) Too much material was included for one meeting. (4) There is much repetition in the films, and if given in several meetings, important points would be emphasized better. (5) The course should consist of several one-half hour periods. (6) Other subjects such as history and the background of Public Health Service, etc., should be added. (7) Presentation of a certificate at completion of course would be helpful. (8) Sessions should be varied and spread out over a period of time. (9) The psychology of such a course is good. It gives the men who are actually doing the work the feeling that their job is an important one, and that they are part of the organization. In addition, it prepares them to do their work more efficiently and to meet and inform the public more adequately. This creates a feeling of responsibility for the success of the work.

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Films used in the Virginia Field Training Course are available to the States for loan. Additional 16 mm. films available for short-time loans for this type of training are: MOSQUITOES, a U.S.D.A. black and white silent film giving a general account of the economic importance of mosquitoes; MALARIA CONTROL, a T.V.A. color, sound film giving a general account of malaria control with special reference to T.V.A. problems.

QUESTION	Number Marked True	Number Marked False	Per Cent Correct
1. Paris green kills all kinds of mosquito larvae.	7	37	84.2
2. Old crank case oil is a good mosquito oil	16	28	63.7
3. In dusting a pond, be sure to get the dust on the water where plants are growing	44	0	100.0
4. You can tell the female mosquito because the front part of her head is bushy.	10	34	77.2
5. The malaria mosquito has 4 black spots on its wings . .	43	1	97.7
6. The malaria mosquito breeds only in water that is more than 2 inches deep	6	38	86.5
7. You can recognize an *Anopheles* larva because it lies flat just under the surface of the water	43	1	97.7
8. Dipping for *Anopheles* larvae should be done where there are plants and floating material in the water rather than in the open water.	40	4	91.0
9. You can tell the *Anopheles* mosquito because it "stands" on its head when it bites	44	0	100.0
10. Malaria mosquitoes generally fly 5 miles	4	40	91.0
11. Some mosquitoes do not breed in water but breed in weeds and tall grass	17	37	84.2
12. Male quads carry malaria germs	3	41	93.2
13. Most people who get malaria die from it	2	42	95.5
14. All kinds of *Anopheles* mosquitoes are good carriers for malaria germs	5	38	86.5
15. A malaria mosquito must bite someone with malaria before it can give the disease to someone else.	44	0	100.0
16. Some adult mosquitoes live only a few weeks, while others live from one season to the next	33	11	75.0
17. There are 4 stages in the mosquito life cycle: the egg - larva - pupa - adult	44	0	100.0
18. Good drainage eliminates water and therefore is a method of controlling mosquito production	44	0	100.0
19. A light trap is used to find out what kinds and how many mosquitoes are present	44	0	100.0
20. Drainage ditches must be kept open in order to do a good job	44	0	100.0
GENERAL AVERAGE			91.27

HEADQUARTERS NOTES

STATE ORGANIZATION FOR TYPHUS CONTROL

The Typhus Control state organization generally consists of a State Director and an Assistant State Director. In some instances, the same administrative office handles investigations and procedures for typhus, malaria, and *Aedes aegypti* control. Through a consolidation of these three, more economical, efficient, and effective control may be attained. The following includes a list of the State Directors and Assistant State Directors from the nine southern and southeastern states in which typhus control procedures are most active.

ALABAMA - Dir., State San. Engr. T. H. Milford; Asst. Dir., Asst. San. Engr. W. H. Gilmore.

FLORIDA - Dir., State San. Engr. J. B. Miller; Asst. Dir., Exec. Asst. George S. Bote.

GEORGIA - Dir., San. Engr. Roy J. Boston; Asst. Dir., not yet appointed.

LOUISIANA - Dir., Dr. R. P. Kandle; Asst. Dir., Typhus Control Officer Graves J. Grant.

MISSISSIPPI - Dir., State San. Engr. H. A. Kroeze; Asst. Dir., Asst. Engr. J. E. Johnston.

NORTH CAROLINA - Dir., State San. Engr. J. M. Jarrett; Asst. Dir., San. Engr. E. L. Hinton.

SOUTH CAROLINA - Dir., Princ. San. W.W. Hane; Asst. Dir., Engr. Aide John C. Brown.

TENNESSEE - Dir., Dr. C. B. Tucker; Asst. Dir., Sr. San. Engr. P. W. Purdom.

TEXAS - Dir., Dr. George W. Cox; Asst. Dir., not yet appointed.

IN-SERVICE TRAINING ACTIVITIES

S. A. Eng. (R) E. P. Dubuque and trainees including Asst. Engr. (R) James W. Cunningham, Asst. Engr. (R) Byron Candage, Jr. Asst. Engr. (R) Frank C. Fromherz, San. Loren P. Stephenson, and Mr. Shu Fang Wang, a San. Engr. visitor from China, attended the Typhus Control School at Savannah, Georgia, July 24-25.

Trainees of the 37th In-Service Training and Orientation Course, went to the Emory University Field Station and to Dawson, Georgia, for part of their field training.

One of the Atlanta Boy Scout Camps and the 4-H Club Camp were used as residual spray training areas during the July In-Service Training and Orientation Course.

NEW ASSIGNMENTS

New assignments for the month of July include: Sanitarian Loren P. Stephenson to Moultrie, Georgia for typhus control; Art Designer Helen Pope to the Training Aide Section at Headquarters; Editorial Clerk Elizabeth M. Glenn to the Editorial Section of Training and Education Division; Engr. Aide Henry E. Reynolds, Jr. to Emory University Field Station; and Asst. Engr. (R) Byron Candage to Louisiana.

TRANSFERS

Transfers for July include: San. (R) John J. Essex from Dallas, Texas to Hdqts. Med. Div.; San. Harry C. Essick from Mobile, Ala. to Hdqts. Eng. Div.; S. A. San. (R) Charles E. Gerhardt from Rec. & Stat. to Hdqts. Ent. Div.; S. A. San. John M. Ellis from Harmon Gen. Hospital to Rec. & Stat. at Hdqts.; Asst. San. (R) Robert Samuels from Louisiana to Ala. to work on the extended malaria program; S. A. Surg. David S. Ruhe from N.I.H. at Atlanta Penetentiary to Hdqts. Training and Diag. Laboratory.

NEWLY COMMISSIONED OFFICERS

Newly commissioned officers for the month of July include: S. A. San. (R) Marion M. Brooke, formerly Assoc. Prof. in the University of Tennessee College of Medicine at Memphis, to take charge of the Dept. of Parasitology, Diag. and Training Laboratory; Jr. Asst. San. (R) Andrew T. Still to Santee-Cooper Area in South Carolina; Asst. Eng. (R) James W. Cunningham to the State Board of Health in Alabama; Jr. Asst. Engr. (R) Frank C. Fromherz to Tennessee.

DIVISION NOTES

NEW FILMS RELEASED

"IT'S UP TO YOU," is a 17 min., two reel, sound movie in color. It shows the methods used by one city in controlling the *Aedes aegypti* mosquito to decrease the threat of dengue and yellow fevers. This film is available for unrestricted distribution. Production number is MCWA-TE-4-016.

"RODENT ECTOPARASITE CONTROL WITH DDT," a 15 min. black and white film strip with sound, portrays the signs and habits of rats as well as the use of DDT dusting in the control of rodent ectoparasites. Distribution is unrestricted. Production number is MCWA-TE-5-027.

"EVALUATING DDT DUSTING IN MURINE TYPHUS CONTROL," is a black and white sound film strip demonstrating methods of collecting rodent ectoparasites and taking blood samples, the means of transmitting them to the laboratory and the way in which results are evaluated. It is available for unrestricted distribution. Production number is MCWA-TE-5-026. This film, as well as the one, "RODENT ECTOPARASITE CONTROL WITH DDT," is being revised, and the new films will replace the originals as soon as possible.

EMORY UNIVERSITY FIELD STATION

Asst. San. (R) John W. Zukel has carried out a number of experiments at Emory Field Station, using fluorescent compounds for marking anopheline mosquitoes. Frequently, when investigations are made of the life cycles of mosquitoes and other insects, it is necessary to mark the specimens in such a way that they can be recognized when later collected and examined. Previous investigators made use of dyes for marking specimens. These were either in solution or in the form of small particles and metalic dusts. However, when these methods were used, the investigator had to handle each individual separately when he looked through collections for marked specimens. This procedure is time consuming.

The method presented by Asst. San. (R) Zukel makes use of fluorescent compounds for marking adult specimens of *Anopheles quadrimaculatus* Say, and later for detecting these individuals under an ultra violet light. Anthracene rhodimine B and fluorescein which produce blue, red and green colors respectively have been used successfully.

Anthracene can be applied either as an aerosol or as a dust mixed with gum arabic. The aerosol is made by using heat to vaporize the anthracene in a closed chamber. Particles with a mean diameter of 6.7 microns are produced. Exposure of caged specimens for five minutes to an aerosol concentration of 10.0 mg. per liter of air, produces homogenous deposits of particles on the exoskeleton of the insects. Apparently, this does no harm to the specimens.

When used as a dust, anthracene is mixed with gum arabic in water in the ratio of 1 part anthracene to 2 parts gum arabic. The mixture is evaporated to dryness and ground to a powder. Specimens are dusted with the powder, then placed in an atmosphere of saturated humidity for 15 minutes. This causes the particles to deliquesce and adhere to the insects. The use of gum arabic as a diluent provides a firm adhesion which prevents contamination of unmarked specimens during the process of collecting.

Rhodamine B and water-soluble fluorescein can be used to dye gum arabic at a concentration of 10.0 milligrams of dye to 3.0 grams of gum arabic. The resulting mixture is used as the anthracene dust for marking specimens.

By using this method, large numbers of individuals are marked easily, and the examination of several hundred specimens can be made in a few minutes.

CARTER MEMORIAL LABORATORY NOTES

TYPHUS CONTROL INVESTIGATIONS

A number of conclusions have been reached concerning the effects of 10% DDT dust when applied to rat holes, burrows, and runs in infected buildings, in moderate to heavy doses (5 to 10 lbs. per establishment.) Approximately one week after dusting, 99.3% reduction in the density of *Xenopsylla cheopis*, the oriental rat flea, had been achieved. This corresponds to the degree of control attained against rat fleas in general. Twenty eight to fifty days following dusting, the flea population still remained 94.6% below its pre-treatment level. Data from 3 establishments indicate that the flea population remains at this level from 53 to 84 days following the treatment.

Occasionally, rats with comparatively large numbers of fleas were caught after treatment. However, most of these were taken in untreated portions of establishments, and in one instance, a trapped specimen was undoubtedly an invader from some other establishment. This leads to the supposition that the rat population in a large building may consist of a number of colonies whose members range only in restricted areas of the building. If this is true, the entire establishment must be given a thorough treatment when dusted, before complete control of rat ectoparasites can be expected.

A week following treatment, rat mite and rat louse populations per rat were reduced 68.7% and 73.5% respectively. Control at later periods cannot be indicated, because a normal seasonal reduction takes place among these species during the summer months.

EFFECTS OF GREASE ON DDT TOXICITY

Experiments show that kitchen grease deposits on walls of ordinary households cause DDT toxicity residue losses ranging from 5 to 25% beyond that occuring in natural aging of DDT. Although it has not been tested, dust deposits may decrease DDT residual toxicity.

EFFECTS OF DDT UPON POULTRY

A question arising in connection with rural dusting procedures, is the possible danger of dusting chicken coops where the dust may fall on exposed feed. The floor of a coop containing large roosters was dusted with 10% DDT dust at the rate of 1 lb. to 200 sq. ft. The roosters were fed a mixture of scratch feed and mash which was scattered on the floor and thus became mixed with DDT dust. After 12 days of exposure, no adverse effects on the roosters had been observed. Tests using month old chicks will be made later.

Twenty Plymouth Rock Chickens eight and nine months old, were allowed to run freely on plots of variously aged cow manure that had been sprayed with 1/3 to 2/3% DDT xylene-triton emulsion at dosage rates of 1000 to 4000 mg. DDT per sq. ft. of surface. During and after contact periods which ranged from 10 to 17 days, no ill effects were observed, nor were any changes in egg production noticed. As a result of this experiment, it is concluded that ½% DDT emulsion at a rate of 500 to 1500 mg. per sq. ft. may be used as a cover spray around dairies where chickens are the common scavengers in cow manure storage piles.

ANOPHELINE HOST PREFERENCE STUDIES

From a total of 1,614 *Anopheles quadrimaculatus* females collected from unsprayed premises, blood of 4.70% reacted with human antisera. Only .12% of the 800 specimens collected from sprayed premises reacted positively.

EQUIPMENT DEVELOPMENT

Experiments have been conducted using aerosols generated by mechanically atomizing nozzles. This emphasizes air-borne particles, with dosage rates ranging from ½ to 2 gal. of liquid per acre. Various commercial nozzles are found satisfactory for DDT larviciding purposes. Three of these produce particles ranging in size from approximately 100 to 125 microns mass median diameter at 40 to 50 psi., and permit the use of a 30 ft. swath in gentle breezes.

Table II

MCWA Expenditures And Liquidations By Major Items

June 1945

		Continental U. S.	Percentage of Total	Puerto Rico	Percentage of Total
.01	Personal Services	$591,127.49	44.36	$21.109.96	63.45
.02	Travel	23,837.17	1.79	169.15	.51
.03	Transportation of Things	5,105.43	.38	---	---
.04	Communication Service	1,752.20	.13	13.45	.04
.05	Rents and Utilities	5,661.57	.42	---	---
.06	Printing and Binding	1,071.59	.08	---	---
.07	Other Contractual Service	4,711.81	.35	40.00	.12
.08	Supplies and Materials	169,253.37	12.70	11,912.87	35.83
.09	Equipment	530,196.55	39.79	18.00	.05
	Total	$1,332,717.18	100.00	$33,263.43	100.00
	Expenses Other Than Personal Services	$741,589.69	55.64	$12,156.14	36.55

Table III

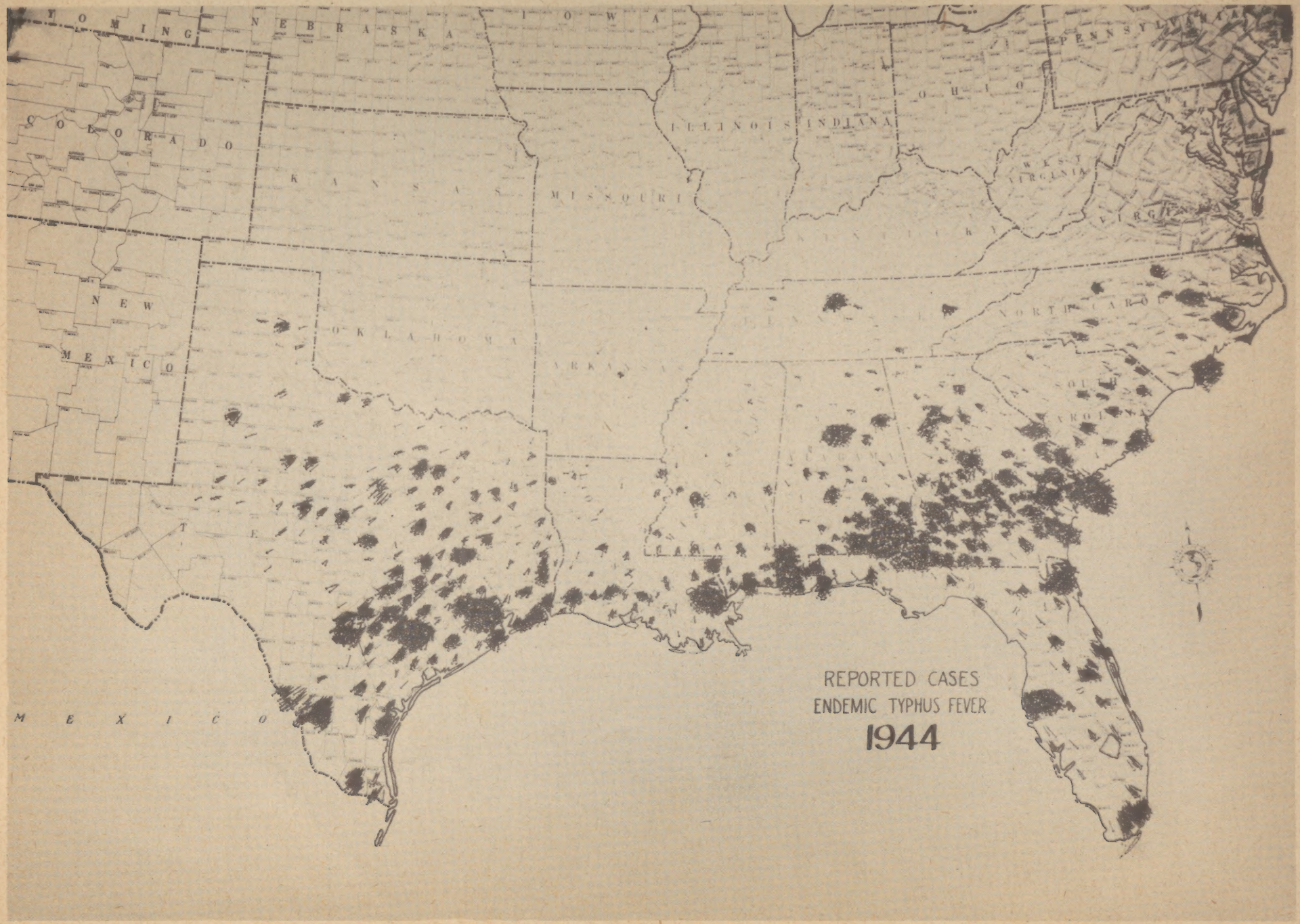
MCWA Personnel And Total Payroll

June 1945

State	Commissioned No.	Commissioned Pay	Prof. & Sci. No.	Prof. & Sci. Pay	Sub-Prof. (1) No.	Sub-Prof. (1) Pay	C. A. F. No.	C. A. F. Pay	Custodial and Per Hour No.	Custodial and Per Hour Pay	Total No.	Total Pay	Percent of Total No.	Percent of Total Pay
Alabama	4	1,280	2	527	23	4,282	2	379	66	8,746	97	15,214	2.30	2.48
Arkansas	9	2,891	4	1,160	37	6.743	7	1,344	364	45,916	421	58,054	10.00	9.48
California	4	1,099	---	---	4	872	3	623	15	2,749	26	5.343	.62	.87
District of Columbia	1	332	---	---	---	---	1	233	---	---	2	565	.05	.09
Florida	8	2,424	4	1,374	95	15,984	9	1,541	164	20,701	280	42,024	6.65	6.86
Georgia	10	3,083	5	1,190	74	13,603	7	1,131	94	11,355	190	30,362	4.51	4.96
Illinois	3	912	2	466	3	568	1	164	25	2,658	34	4,768	.81	.78
Indiana	1	284	---	---	2	385	---	---	10	981	13	1,650	.31	.27
Kentucky	5	1,467	1	284	21	3,498	4	677	48	6,419	79	12,345	1.88	2.02
Louisiana	10	2,921	3	982	53	10,092	9	1,553	269	35.574	344	51,122	8.17	8.35
Maryland	1	248	---	---	2	385	2	438	11	1,513	16	2,584	.38	.43
Mississippi	8	2,383	7	1,860	55	9,630	7	1,172	206	24,755	283	39,800	6.72	6.50
Missouri	2	548	3	785	17	3,195	---	---	149	19,234	171	23,762	4.06	3.88
North Carolina	8	2,262	5	1,561	13	2,562	4	732	166	20,605	196	27,722	4.65	4.53
Oklahoma	4	1,210	3	740	16	3,359	2	223	93	11,981	118	17,513	2,80	2.86
Oregon	---	---	---	---	1	203	---	---	---	---	1	203	.02	.03
South Carolina	11	3,292	6	1,729	51	10,156	13	2,152	411	52,968	492	70,297	11.68	11.49
Tennessee	5	1,467	4	1,165	20	3,255	10	1,779	90	11,228	129	18,894	3.06	3.09
Texas	9	2,704	4	1,333	66	12,105	11	1,766	256	32,806	346	50,714	8.21	8.29
Virginia	1	389	2	696	25	3,226	2	534	118	15,459	148	20,304	3.51	3.32
Aedes aegypti														
Alabama	1	284	---	---	8	1,509	1	164	---	---	10	1,957	.24	.32
Florida	---	---	---	---	27	4,860	---	---	---	---	27	4,860	.64	.79
Georgia	---	---	---	---	5	1,061	---	---	---	---	5	1,061	.12	.17
Louisiana	1	284	---	---	6	1,411	1	164	---	---	8	1,859	.19	.30
South Carolina	1	284	---	---	6	1,091	1	164	---	---	8	1,539	.19	.25
Texas	4	1,135	1	129	27	5,300	2	310	1	170	35	7,044	.83	1.15
Hq. & Dist. (2)	69	22,971	13	3,513	42	7,665	177	29,491	54	7,281	355	70,921	8.42	11.58
Mobile Units	8	2,469	3	818	9	1,289	2	328	33	3,742	55	8,646	1.31	1.41
Puerto Rico	7	2,114	2	677	10	2,312	6	1,297	298	14,710	323	21,110	7.67	3.45
Total	195	60,737	74	20,989	718	130,601	284	48,359	2941	351,551	4212	612,237		
Percent of Total	4.63	9.92	1.76	3.43	17.05	21.33	6.74	7.90	69.82	57.42	100.00	100.00	100.00	100.00

(1) Includes Entomological Inspectors

(2) Includes Headquarters and District Offices, Malaria Survey, Imported Malaria Control, Special Investigations and employees temporarily attached to Headquarters pending assignment to states


WYOMING
NEBRASKA
IOWA
COLORADO
KANSAS
MISSOURI
ILLINOIS
INDIANA
OHIO
PENNSYLVANIA
WEST VIRGINIA
VIRGINIA
NEW MEXICO
OKLAHOMA
ARKANSAS
TEXAS
LOUISIANA
MEXICO
REPORTED CASES
ENDEMIC TYPHUS FEVER
1944